

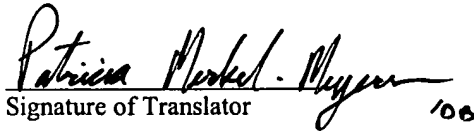


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Date: January 4, 2005

Description of Documents Translated: Patent 2 341 998—Temperature Measuring Device

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51 International Classification: G 01 k, 5/58

FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT OFFICE

52 German Classification: 42 i, 4/01

10

11 Published Patent Application 2 341 998

21 Application number: P 23 41 998.9

22 Application date: August 20, 1973

43 Publication date: July 4, 1974

Exhibition priority: -

30 Convention priority:

32 Date: December 1, 1972

33 Country: German Democratic Republic

31 Application number: WP 167228

54 Title: Temperature measuring device

61 Addition to: -

62 Division from: -

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[VEB Combine for Measuring Technology and Automatic Control Engineering]

Agents pursuant
to §16 of Patent Law: -

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Temperature Measuring Device

The invention concerns a temperature measuring device, which undertakes a linearization, relative to the temperature to be measured, of a non-linear change in path, preferably of metal materials.

It is known that lever configurations or plane motion direct contact mechanisms are used for the linearization in solid expansion by means of temperature influence. Configurations are known that operate, for example, with the aid of auxiliary pneumatic energy, and in which solid expansion is increased and linearized by means of levers, and that sensing of the lever movement is carried out by means of a backing plate - impact plate configuration. Furthermore, we can arrive at a reduction of errors in linearity for temperature measuring devices based on the principle of solid expansion by limiting the measuring range and by the selection of the expansion materials or by the use of specific expansion materials for specific measuring ranges.

The mentioned forms of embodiment have the following drawbacks:

The expenditures in terms of the operating mechanical components are high and additional errors are generated by the friction in the bearing points of the mechanical transfer elements. The configurations are sensitive to impacts and vibrations. A limited range of measurement and certain expansion materials restrict the field of application for which such temperature measuring devices can be used.

The objective of the invention is to avoid the influence created by friction and vibrations and to increase the range of temperature.

The underlying task of the invention is to convert inherently non-linear temperature dependent length changes, for a wider range of temperatures in metal materials, into an output signal that is proportional to the change in temperature and to reduce the susceptibility of known configurations to errors due to vibrations by avoiding levers and joint constructions for the implementation of solid expansion.

In accordance with the invention, the task is resolved in that a known solid expansion sensor, comprised of a reference rod and of an expansion rod, is securely connected to an inherently known inductive transducer - transverse armature, which is comprised of two shell type cores and of one armature, in such a manner that the reference rod is securely connected to the armature and that the

expansion rod is securely connected to the shell type cores and that the reference rod is guided on the one side by a known preloaded element that is elastic in the direction of displacement and is pressed on the other side into the properly formed bearing position in the expansion rod by the elastically preloaded element. In accordance with the invention, the required linearization is achieved in that by properly defining the maximum and temperature dependent armature travel path in conjunction with the selected core cross section of the inductive transducer, the latter exhibits a specific non-linear characteristic curve whose curvature corresponds to that of the expansion rod, but which is from the opposite direction. The characteristic curve of the inductive transducer is determined by the dispersion of the magnetic field in the gap between the armature and the shell type cores on both sides, depending on the position of the armature. The magnetic field only picks up the corresponding dimensions of the shell type core when the armature is in close proximity to one of the shell type cores. The non-linearity of the characteristic curve determined by this solely depends on the constructional configuration and cannot be influenced by any other means.

The only possibility of adapting the curvature of the characteristic curve for the inductive transducer to the curvature of the characteristic curve for the expanding material consists in the ability of adjusting the position of the armature.

To reduce the influence of the ambient temperature, the part of the temperature sensor, which is not exposed to the temperature subject to being measured, is manufactured of a material that has a low expansion coefficient temperature, whereby the extension of the reference rod lying outside of the measured temperature zone is designed as a thin walled tube and forms a narrow air gap together with the outer tube. In this manner, a more or less equal temperature is achieved between the inner and the outer tube, the conduction of heat to the inductive transducer is suppressed and the heat transfer to the atmosphere is improved, which can be magnified even more by means of radiating surfaces.

The technical effect consists in the improvement of the measurement technology parameters, which is thereby achieved in that the non-linear characteristic curve of the temperature dependent length modification of a metal rod is created by the corresponding non-linear section of the characteristic curve of an inductive transducer to be largely linear and that based on the direct connection of the expansion rod with the inductive transducer, additional transfer components and bearing points can be omitted,

which would otherwise influence the parameters of the measuring technology by their sensitivity to the vibrations from the friction.

In the following, the invention shall be more closely detailed based on a form of embodiment:

Figure 1: shows a longitudinal section of the temperature measuring device

Figure 2: shows the path of the characteristic curve for an expansion rod

Figure 3: shows the path of the characteristic curve for an inductive transducer.

In figure 1, a temperature measuring device is represented with a solid expansion sensor. It is comprised of the tube shaped expansion rod 1, of the reference rod 2, of the tube shaped extensions 3 and 4, of the inductive transducer with the shell type cores 6, of the windings 7 and of the armature 8. The reference rod 2 is pressed into the bearing position 10 by means of a preloaded spring 9. The adjustable armature is securely connected to the extension 4 of the reference rod 2 by means of a nut 11 and spring 12. The shell type cores 6 are secured to the extension 3 of the expansion rod 1. Based on the design of the extension 4 as a thin walled tube, the conduction of heat to the inductive transducer 5 is inhibited, and the transfer of heat is promoted via a narrow annular clearance 13 on the extension 3 and heat is conveyed into the atmosphere and is magnified by radiating surfaces 14. The extensions 3 and 4 are manufactured of a material with a low expansion coefficient temperature.

Figure 2 shows the characteristic curve ($s = f(\eta)$) of the expansion rod and figure 3 shows the characteristic curve $U = f(s)$ of the inductive transducer. S_{\max} designates the maximum armature travel path between the shell type cores. In the case of a specific change in temperature $\eta_2 - \eta_1$, a displacement $s_2 - s_1$ is effected by the change in length of the expansion rod and the reference rod. A run from point A to point B is described in the characteristic curve ($s = f(\eta)$). This signifies that for a specific armature position A', there is a modulation of the inductive transducer along the characteristic curve $U = f(s)$ from point A' to point B'.

The curvatures of the characteristic curves are opposed. By changing the position of the armature, the values of the characteristic curve - curvatures are brought closer to one another and the error in linearity is thereby largely reduced.

Based on an appropriate measuring circuit, the value U_0 of the output voltage can be suppressed and the sign can be reversed, so that with an increasing temperature, a voltage signal that starts at zero and increases is made available.

Patent Claims

1. Temperature measuring device, thus characterized that a known solid expansion sensor, comprised of a tube shaped expansion rod (1) and of a reference rod (2), is securely connected directly to an inherently known inductive transducer (5), whereby the reference rod (2) is connected to the armature (8) and the expansion rod (1) is connected to the shell type cores (6) of the inductive transducer (5), and that the transducer (5) has a non-linear characteristic curve whose curvature corresponds to that of the expansion rod (1), but is from the opposite direction.
2. Temperature measuring device in accordance with claim 1, thus characterized that the armature (8) of the inductive transducer (5) is adjustable.
3. Temperature measuring device in accordance with claim 1 and 2, thus characterized that the extension (4) of the reference rod (2) lying outside of the measured temperature is designed as a thin walled tube and forms a narrow air gap (13) together with the outer tube.
4. Temperature measuring device in accordance with claims 1 through 3, thus characterized that the extensions (3; 4) of the expansion rod (1) and of the reference rod (2) lying outside of the measured temperature are manufactured of a material with a low expansion coefficient temperature.
5. Temperature measuring device in accordance with claims 1 and 2, thus characterized that the reference rod (2) is guided in the direction of displacement on the one side by a known preloaded element (9) and on the other side, is pressed into the properly formed bearing position (10) in the expansion rod (1) by the elastically preloaded element (9).

List of reference numbers used

1	tube shaped expansion rod
2	reference rod
3	extension
4	extension
5	inductive transducer
6	shell type cores
7	windings
8	armature
9	elastic element
10	bearing position
11	nut
12	spring
13	air gap
14	radiating surfaces
A; B	characteristic curve points
U_o	output voltage
s	travel path
η	temperature

[See source for 2 graphs]

Figure 2

Figure 3

[See source for drawing]

409827 / 0212

42i 4-01 Application date: 08/20/1973 Publication date: 07/04/1974

Figure 1